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Buckley, R. W. (2002). New Textile Concepts for Use in Control of Body Environments. Heathcoat (John) and CO LTD Devon, United Kingdom. (DTIC No. ADP012409)

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Abstract: Double layer, or three dimensional, textile constructions have been manufactured for some years by Heathcoat in the form of spacer fabrics based on a warp knitted construction and also woven double layer products used in the civil engineering industry. The upper and lower layers of such products are interconnected with common threads during the manufacturing process. This paper conveys the new functional products that are becoming available in double layer constructions from the John Heathcoat textile company. The R&D Department at Heathcoat have developed a series of novel composite fabrics based on double layer substrates, categorized for discussion as follows: Woven: I. Coated - no spring support 2. Coated with spring support Warp and Weft Knitted: 3. Spring support, no coating 4. Spring support, coated both faces.

Camenzind, M., Weder, M., and Hartog, E. D. (2002). Influence of Body Moisture on the Thermal Insulation of Sleeping Bags. Swiss Federal Labs for Materials Testing and Research, Gallen, Switzerland. (DTIC No. ADP012412)

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Abstract: The influence of body moisture on the insulation properties of 10 different sleeping bags designed for extreme conditions below - 30 deg C, as well as the capability to be used at such low temperatures was investigated in a shared research project of TNO and EMPA. The sleeping bags were assessed with standardized laboratory tests, human subject tests and a system assessment with specialized apparatus. It tuned out that the moisture released at such low temperatures leads to condensation within the sleeping bag and ice between the bag and the underlay which reduces the thermal insulation considerably. Even at - 20 deg C both human subject tests and laboratory measurements demonstrate that the sleeping bags investigated have already reached or even exceeded the limit for which comfortable sleep is possible. Details on the limits of use given by the manufacturers are normally based on computer calculations. With two different computer models the calculated temperature ranges were compared to the measurements. It seems necessary to make further investigations in the field of simulation of heat and moisture transfer through complex compositions of textile layers.

DeWeese, R., and Gowdy, V. (2002). *Human Factors Associated with the Certification of Airplane Passenger Seats: Seat Belt Adjustment and Release (Report No. DOT/FAA/AM-02/11).* Federal Aviation Administration, Civil Aeromedical Institute, Oklahoma City, OK. (DTIC No. ADA404285)

http://handle.dtic.mil/100.2/ADA404285

Abstract: Two separate studies were accomplished to investigate human factors issues related to the use of lap belts. Human performance trials were conducted under two protocols to

measure and assess: (1) seat belt tension adjustment during normal flight and emergency landing conditions, and (2) the effects on passenger emergency egress performance related to the lift-latch release angle of typical lap belts. In the lap belt tension adjustment study, subjects were asked to sit in a typical passenger seat and adjust the lap belts as they normally would for take-off or landing during a commercial flight. Participants were then asked to adjust the lap belts as if they were anticipating an emergency landing. The airplane seat used in this study was instrumented to measure the tension in the lap belt, which was recorded for both the normal and emergency conditions. A total of 1182 subjects participated in this study. An analysis of results indicate that most passengers (90%) tighten the lap belt to a tension less than 7 lb. during normal flight conditions and less than 10 Lb. for an anticipated emergency. These data indicate that the tension adjustment of lap belts restraining anthropomorphic test dummies in airplane seat certification tests should not exceed 10 lbs. to be representative of belt tension applied by a typical passenger. The current standard practice for adjusting the belt tension prior to these tests was evaluated and found to be adequate in light of these findings. The lift-latch release angle experiments were designed to study lap belt restrained human subjects as they released the belt buckle and proceeded to egress from a typical passenger seat. Some foreign regulatory authorities require the release angle to be between 700 and 950, whereas, typical U.S. buckles release between 450 and 600. Three lap belts with latch release angles of 300, 600, and 900 were installed on a triple passenger seat.

Gregg, R. L., Banderet, L. E., Reynolds, K. L., Creedon, J. F., and Rice, V. J. (2002). *Psychological Factors That Influence Traumatic Injury Occurrence and Physical.* Army Research Institute of Environmental Medicine, Military Performance Division, Natick, MA. (DTIC No. ADA404618)

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Abstract: This 9 month prospective study, conducted at the U.S. Army Sergeants Major Academy (USASGMA), examined the association of selected psychological variables (e.g., measures of tension/anxiety, sleep disturbance, Type A behavior pattern with injury occurrence and physical performance in 126 soldiers. ANOVA and logistic regression analyses revealed significant relationships between: (1) Traumatic injury occurrence and mean tension/anxiety scores, (2) Mean self-reported sleep disturbance scores and traumatic injury occurrence, (3) The Type A behavior pattern (abbreviated Jenkins Activity Survey) and number of sit-ups repetitions completed in 2 minutes, one component of the Army Physical Fitness Test (APFT), and (4) The Type A behavior pattern and total score APFT. No significant associations were found for mean tension/anxiety scores and overuse injuries, or Type A behavior pattern and two mile run time or number of push-up repetitions completed in 2 minutes. These data suggest traumatic injury occurrence is influenced by tension/anxiety and disturbances in sleep habits. Additionally, individuals with higher Jerkins Activity scores (characteristic of the Type A behavior pattern) perform better physically.

Havenith, G. (2002). Blowing Hot and Cold: Protecting Against Climatic Extremes (RTO-MP-076, AC/323(HFM-061)TP/40). NATO Research and Technology Agency, Cedex, France. (DTIC No. ADA403853)

http://handle.dtic.mil/100.2/ADA403853

Abstract: Exposure to heat and cold as well as the thermal stress induced by protective clothing strongly influences operational effectively of the soldier. On 8-10 October 2001, NATO

and Partner for Peace nationals met in Dresden Germany, to discuss the interaction between the climate, the clothing and equipment, and the physiology of the soldier in relation to its impact on the soldier's health and operational performance. 118 people participated in the meeting, originating from 20 countries, attending a total of 43 papers. Session topics were: 'Advances in clothing technology', advanced technology for heat stress mitigation', military benefits of physiological adaptation to heat and cold', and modeling monitoring and thermal limits'. A part from the military aspects also the spin-off of the research for civilians and emergency services was discussed and this was seen as an important application of the research findings. Other observed themes were: (1) The sharply increased use of manikins in clothing and threat (steam, fire) evaluation; (2) The successful development of personal cooling systems and the development of good evaluation methods; (3) The use of spacer materials in heat protection as well as for creating spacers in clothing through which air for active cooling can be provided; (4) The continued development of NBC protective clothing towards minimal heat stress; (5) The optimization of heat and cold adaptation of soldiers before going on missions to respective areas; (6) The increase in successful use of models for prediction of heat and cold stress, survival time (hypothermia), frost bite risk, water requirements, clothing thermal performance, and for hypothesis testing in terms of the thermoregulatory system; (8) The development of new indices; for classification of physiological strain (heat and cold) and for the climate.

Just, J., Weiss, R., and Gehse, H. (2002). GKSS - Advanced Integrated System Concept for Full Protection and Heat Stress Mitigation. System Design and Engineering, GMBH Markdorf, Germany. (DTIC No. ADP012421)

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Abstract: The increased demand for protection of the human body against external threats and environmental conditions has led modularity of components for countering these threats and environmental conditions. However, the higher the degree of protection the more negative influence on human performance could be observed. The degradation of human performance situation is caused by multiple layered - onion like - protection garments keeping the body away from natural heat exchange mechanisms. This can be recognized in particular when looking into combat pilot equipment where the result is known as heat stress problem. This degradation is getting even worse when protective garment has to be impermeable as well as semi-permeable. As the operational workload remains it adds to the burden caused by the protective garment resulting in excessive perspiration and finally, leads to dehydration. The alternative approaches to overcome these deficiencies vary from modular components for individual protection needs with no conditioning via liquid conditioning to air cooling solutions. However, the solutions so far have been based on single component optimization with substantial deficits when trying to integrate them. Contrary to these approaches the GKSS - Full Coverage Protection System - approach considers the integrated system concept from the very beginning avoiding the deficiencies encountered with single components for single threat solutions. The GKSS, designed for the most challenging protection needs, comprises helmet, suit and the peripheral components using air ventilation for micro climatization of head and body. The GKSA suit design follows a three layer concept - the outer layer for threat/environment protection, the middle layer for distance keeping (air flow/insulation), and the inner layer for sweat transportation, insulation and limited flame protection. This concept applies in principle for the helmet as well.

Knapik, J. J., Bullock, S., Hauret, K., Wells, J., and Hoedebecke, E. (2002). *Administrative and Safety Evaluation of a Proposed Army Physical Readiness Test (Report No. USACHPPM-MA-7G039-02).* Army Center For Health Promotion And Preventive Medicine (Provisional), Aberdeen Proving Ground, MD. (DTIC No. ADA403887)

http://handle.dtic.mil/100.2/ADA403887

Abstract: The purpose of this investigation was to perform an administrative and safety assessment of the proposed Army Physical Readiness Test (APRT). Subjects were Ordnance School students in Advanced Individual Training (AIT) at Aberdeen Proving Ground, Maryland. Test items consisted of the standing long jump, power squat, heel hook, 300-yard shuttle mn, push-ups and 1-mile mn. The procedures followed were those outlined in a draft Army Field Manual 3-22.20 (Physical Readiness Training). A total of 372 soldiers (330 men and 42 women) performed some part of the test but 39 men and 10 women chose not to complete all six events. The majority of men and women who did not complete the testing after starting it complained of being dizzy, 'sick' or lightheaded (31%) or of having leg pain (31%). Descriptive statistics and percentile rankings for the 6 events are reported in this paper but limitations of these data include the subject population (young AIT students), the fact that soldiers had no opportunity to practice the test events, and that some soldiers lacked the motivation for the maximal effort required for the test. The APRT required a relatively large amount of equipment. Army warm-up tops were baggy and this made it difficult to observe whether or not soldiers were properly performing the heel hook and push ups. Eased on data, test observations, and a review of the literature the following major recommendations were made. Eliminate the heel hook because of the potential for head and spine injury and substitute another test that involves the trunk musculature. Eliminate the power squat because this may encourage soldiers to perform an excessive number of squatting exercises, which may be associated with osteoarthritis. Reduce the number of test events because the fatigue generated by the 6 event test could increase the risk of injury.

Knoefel, H. (2002). *Operational and Thermophysiological Needs for Metabolic Heat Dissipation: Ways, Deviations, and Progress.* German Air Force Institute of Aviation Medicine, Manching, Germany. (DTIC No. ADP012420)

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Abstract: The thermophysiological regulation of body temperature is partially or completely inhibited by protection suits especially when several qualities of protection are needed. The result of an insufficient thermophysiological response is heat stress with decreased mental and physical performance of the human being. To get an idea about the amount of heat stress different physiological values are measured: metabolic rate, heat frequency, mean skin and core temperature, sweat rate, psychological performance tests, loss of energy in W/sq cm, etc. This variety of different data demonstrates the difficulty to get an exact picture how much heat stress can be tolerated under different circumstances. Nobody doubts that technical cooling devices are necessary to keep the human performance tolerable and to avoid a collapse that may lead to death: heat reflecting clothes, cooling jackets filled with water or carbon dioxide snow, two-layered protection suit with cool pressurized air, etc. The best solution is the natural one: (1) allow the body to sweat and transport the humidity away to keep the environment as dry as possible to avoid a saturation of humidity surrounding the human body. (2) Clothing must not be close to the body in order to allow circulation of air to get rid of the evaporated sweat (chimney-effect).

Mentain, S. J., Latzka, W. A., Hoyt, R. W., and Swaka, M. N. (2002). Sustaining Hydration in Hot Weather. Army Research Institute of Environmental Medicine, Natick, MA. (DTIC No. ADP012433)

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Abstract: Maintenance of water and electrolyte balance is important for sustaining optimal performance. Dehydration produces greater thermal and cardiovascular strain during prolonged work; with the magnitude of added strain proportional to the magnitude of water loss. Dehydration also degrades morale and the desire to work. Body water deficits of as little as 2% normal body mass have been accompanied by impaired cognitive and physical performance. Furthermore, water deficits of 5% to 7% of normal body mass are generally associated with dyspnea, headaches, dizziness, and apathy. This presentation will summarize work that the U.S. Army Research Institute of Environmental Medicine has been doing to sustain proper hydration of soldiers during training.

Pisano, N. D. (2002). *Technical Performance Measurement, Earned Value, and Risk Management: An Integrated Diagnostic Tool for Program Management.* Anti-Submarine Warfare Systems Project Office, Washington, D.C. (DTIC No. ADA404646)

http://handle.dtic.mil/100.2/ADA404646

Abstract: This research effort, sponsored by the Program Executive Office for Air ASW, Assault, and Special Mission Programs (PEO(A)), is known as the Navy PEO(A) Technical Performance Measurement (TPM) System. A retrospective analysis was conducted on the T45TS Cockpit-21 program and real-time test implementations are being conducted on the Federal Aviation Administration's (FAA) Wide Area Augmentation System (WAAS) program, the Navy's H-1 helicopter upgrade program, and is currently under consideration for other test implementations across the Department of Defense (DoD) and in private industry. Currently-reported earned value data contains invaluable planning and budget information with proven techniques for program management, however, shortcomings of the system are its emphasis on retrospection and lack of integration with technical achievement. The TPM approach, using the techniques of risk analysis and probability, offers a promising method to incorporate technical assessments resulting systematically from technical parameter measurements to derive more discrete management data sufficiently early to allow for cost avoidance. Results obtained from TPM pilot programs, particularly the Cockpit-21 program, support this premise. Several preliminary issues of interest and conclusions are delineated in this paper that demonstrate that the TPM methodology is a powerful integrated diagnostic tool in support of the new paradigm advocating a multidisciplinary approach to program management. It also promises to provide a powerful new tool in proactive risk management.

Richards, M. G. M., and Mattle, N. G. (2002). A Sweating Agile Thermal Manikin (SAM) Developed to Test Complete Clothing Systems Under Normal and Extreme Conditions. Swiss Federal Labs for Materials Testing and Research, Gallen, Switzerland. (DTIC No. ADP012411)

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Abstract: Moisture transport, thermal insulation and their interaction influence both the comfort and protective properties of clothing systems. Depending on the environmental conditions and

clothing design, wind and repetitive body movements can increase the transport of heat and moisture away from the body. Thus a thermal manikin designed to test clothing realistically, particularly under extreme conditions, should be able to sweat and perform such movements. SAM is a newly developed thermal manikin capable of simulating even heavy work conditions, with sweat rates of up to 4 litres per hour and human movements such as walking and climbing. The anatomically-formed body is divided into 30 sectors, each heated separately with its own average surface-temperature sensor. In total 125 sweat outlets are distributed over the body surface, with which both vapour and liquid sweating can be simulated over all the body or just chosen parts. SAM is designed to operate at temperatures between - 30 and 40 deg C, with relative humidities ranging from 30 to 95% and up to high wind speeds. SAM compliments the existing array of sweating body-part simulation systems at EMPA, such as the sweating head ALEX and the sweating torso, by adding the capability of measuring whole-body clothing systems under realistic reproducible conditions and reducing the need for expensive human tests.

Uedelhoven, W. H., Kurz, B., and Roesch, M. (2002). Wearing Comfort of Footwear in Hot Environments. Bundeswehr Research Institute for Materials, Explosives, Fuels, and Lubricants, Erding, Germany. (DTIC No. ADP012417)

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Abstract: The climatic wearing comfort of military footwear greatly influences the performance of the soldier. Particularly in hot and/or humid environments insufficient wearing comfort of footwear can cause severe problems. Considering that the formation of blisters can be considerably reduced if the feet are kept as dry as possible, means should be provided to reduce the humidity close to the surface of the foot. Even though a great diversity of so called 'functional' socks and 'breathable' shoes are available on the market today, there is still a lack of reliable and objective methods to simulate sweating inside the footwear at different levels of metabolic rate and to measure the resultant temperatures and relative humidities. It is, therefore, difficult to judge or compare different footwear systems (consisting of shoes, socks and inlay soles) with respect to their influence on the climatic wearing comfort.